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Washington, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

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MEMORANDUM **May 11, 2009**

SUBJECT: Refined Tier II Drinking Water Exposure Assessment for the Section 3 New Use Registration of Oxamyl on Dry Bulb Onions, Garlic and Shallots.

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The Agency is considering a Section 3, New Use registration of oxamyl [(*EZ*)-N,N-dimethyl-2-methylcarbamoyloxyimino-2-(methylthio)acetamide; CAS# 23135-22-0; PC Code 103801] on dry bulb onions, garlic, and shallots. This proposed action would modify the current uses of oxamyl on dry bulb onions and garlic, including elimination of the currently labeled

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geographic limitations, and expand the use on onions to include shallots. Use on dry bulb onions is currently limited to California, Oregon, Idaho, Washington, Michigan, New Mexico, and Texas. Use on garlic is currently limited to Oregon and two counties of California, Modoc and Siskiyou. Further modifications include consolidation of application directions specific to pest pressure and application method into a single set for the proposed uses on dry bulb onions, garlic, and shallots.

This assessment follows the 2009 Revised Tier II Drinking Water Exposure Assessment for the Section 3 New Use Registration of Oxamyl on Sugar Beets (DP barcode 351367; USEPA, 2009) and does not reproduce the full drinking water exposure assessment. As in the previous assessment, this assessment includes estimated exposure resulting from the proposed and currently labeled maximum use patterns and characterization of the estimated exposure resulting from an actual usage pattern on onions, as recently described (DP barcode 359723; USEPA, 2009a) by the Biological and Economic Analysis Division (BEAD).

Exposure estimates from the proposed and currently labeled maximum use patterns previously and currently assessed, using regional PCAs and current models, are listed below in **Table 1**. The use on carrots resulted in the maximum 1-in-10-year peak and annual mean estimated exposure values in surface water. The use on ginger root resulted in the maximum exposure values in ground water. Because HED no longer compares surface water estimated drinking water concentrations (EDWC) to point levels of concern, the 30-year daily time series of EDWCs that the point estimates for surface water represent are presented to HED for probabilistic modeling in support of human health dietary risk assessment.

Table 1. Refined estimated drinking water concentrations (EDWC) from maximum use patterns of oxamyl (proposed uses on dry bulb onions, garlic, and shallots in italics; maximum values in bold).

Drinking water source (model/data source)	Use (modeled rate)	Regional PCA	1-in-10-year peak (µg/L)	1-in-10-year annual mean (µg/L)	30-year mean (µg/L)
Surface water (PRZM/EXAMS)	Apples (2 lbs a.i./A/year)	87%	27	0.6	0.3
	Carrots (7 lbs a.i./A/year)	85%	**300**	**6.4**	2.7
	Citrus (6 lbs a.i./A/year)	38%	70	1.6	1.0
	Cotton (3 lbs a.i./A/year)	85%	123	2.4	1.2
	Cucumbers (6 lbs a.i./A/year)	67%	147	3.3	1.8
	Dry bulb onions, Shallots, Garlic (4.5 lbs a.i./A/year)	*80%*	*108*	*2.3*	*0.7*
	Mint (4 lbs a.i./A/year)	87%	12	0.4	0.2
	Non-bearing fruit (8 lbs a.i./A/year)	38%	124	3.1	1.5
	Onions (current label; 4-4.5 lbs a.i./A/year)	67%	90	1.9	0.5
	Peppers (6 lbs a.i./A/year)	85%	256	4.7	2.2
	Potatoes (8 lbs a.i./A/year)	85%	243	**6.4**	**3.1**
	Sugar beets (4 lbs a.i./A/year)	87%	116	2.0	0.9
	Tomatoes (8 lbs a.i./A/year)	85%	208	4.5	2.4

Table 1. Refined estimated drinking water concentrations (EDWC) from maximum use patterns of oxamyl (proposed uses on dry bulb onions, garlic, and shallots in italics; maximum values in bold).					
Drinking water source (model/data source)	**Use (modeled rate)**	**Regional PCA**	**1-in-10-year peak (µg/L)**	**1-in-10-year annual mean (µg/L)**	**30-year mean (µg/L)**
Ground water (SCI-GROW)	Ginger root (10 lbs a.i./A/year)	N/A	**1.3**	**1.3**	**<1.3**
	Potatoes (9 lbs a.i./A/year)	N/A	1.1	1.1	<1.1
	Carrots, Tomatoes, Non-bearing fruit (8 lbs a.i./A/year)	N/A	1.0	1.0	<1.0
	Citrus, Cucumbers, Peppers (6 lbs a.i./A/year)	N/A	0.75	0.75	<0.75
	Dry bulb onions, Garlic, Shallots (4.5 lbs a.i./A/year)	*N/A*	*0.57*	*0.57*	*<0.57*
	Mint, Sugar beets (4 lbs a.i./A/year)	N/A	0.50	0.50	<0.50
	Cotton (3 lbs a.i./A/year)	N/A	0.38	0.38	<0.38
	Apples (2 lbs a.i./A/year)	N/A	0.25	0.25	<0.25
Ground Water (PGW studies)	Cotton (4 lbs a.i./A/year)	N/A	**3.9**	N/A	N/A
	Tomatoes (8 lbs a.i./A/year)	N/A	1.5	N/A	N/A

In 2008, HED indicated that dietary levels of concern (for food plus water and accounting for number of eating occasions per day) are generally exceeded when EDWC time series are represented by a 1-in-10-year peak value near or above 80 µg/L (personal communication with Sheila Piper, Nov. 19, 2008). This indicates that the maximum use patterns for most modeled uses listed in **Table 1**, including the proposed uses on dry bulb onions, garlic, and shallots, may result in exceedances of dietary levels of concern. As a next step for characterization, EFED modeled a use pattern based on the usage data provided by BEAD when the 1-in-10-year peak EDWC for a maximum use pattern exceeded 80 µg/L for a given PCA region. This actual use pattern represents the average number of applications per year and the maximum application rate that were reported for use on onions in a relevant region of the United States. This additional modeling estimates exposure from the lower application rate, which characterizes the potential exposure that may result if the labeled rate were reduced to this lower modeled rate. Acute (1-in-10-year peak) estimated drinking water exposure estimates resulting from this actual use pattern did not exceed 80 µg/L.

As discussed in the previous assessment (DP barcode 351367; USEPA, 2009), available monitoring data suggest that oxamyl may be detected in ground water and surface water at up 395 µg/L and 2.8 µg/L, respectively, in vulnerable areas. However, maximum ground water concentrations observed in most monitoring studies were typically lower. The data suggest that oxamyl is not likely to be found in most surface waters and, when it is found, is not likely to persist. The compound is not expected to persist in neutral to alkaline ground water. Prospective ground water monitoring and non-targeted monitoring indicate that oxamyl may persist in some acidic ground water environments.

The major transformation products of oxamyl, oxime [methyl-2-(dimethylamino)-N-hydroxy-2-oxoethanimidothioate] and dimethyloxamic acid [DMOA; (dimethylamino)oxoacetic acid] are more mobile and more persistent than the parent, however environmental fate data are too limited to properly assess and characterize their fate in the environment. No transformation products of oxamyl are considered of toxicological concern. Therefore, oxamyl alone is the residue of concern in drinking water that is included in these assessments.

1. USE CHARACTERIZATION

This assessment considers the maximum use pattern of the proposed uses on dry bulb onions, garlic, and shallots (**Table 2**). These uses are proposed to have a consolidated, single set of application instructions on the proposed label. The proposed uses of oxamyl on dry bulb onions and garlic modify currently labeled uses of oxamyl on these crops, including elimination of currently labeled geographic limitations and inclusion of shallots as a newly specified subset of the currently labeled use on dry bulb onions. Use on dry bulb onions is currently limited to California, Oregon, Idaho, Washington, Michigan, New Mexico, and Texas. Use on garlic is currently limited to Oregon and two counties of California, Modoc and Siskiyou. Further modifications of these uses include consolidation of application directions specific to pest pressure and application method.

Table 2. Maximum use pattern for the proposed uses of oxamyl.[a]

Use Pattern	Formula	Geographic Applicability	Single App. Rate (lbs a.i./A)	Max. Number of App.	Seasonal App. Rate (lbs a.i./A)	App. Interval (days)	App. Method
Dry bulb onions, garlic, shallots	Vydate® L	United States	2.0	8	4.5	14	Ground/ chemigation

a The listed use pattern represents the maximum use pattern and does not represent all labeled application methods for these uses.

The maximum use pattern of these consolidated uses is modeled with available modeling scenarios to estimate exposure that is higher than at most potential use sites due to a combination of use pattern and site vulnerability. Seasonal application rates are assumed in this assessment to be annual application rates, as onion, garlic, and shallot crops are not grown more than once per year.

In order to characterize reductions in exposure estimates resulting from potential changes to the proposed use patterns, usage data were requested from BEAD for use on onions for U.S. states where exposure concern was identified in the previous assessment (DP barcode 351367; USEPA, 2009). BEAD provided the requested usage data at the state-level and at the application-level, such as per crop stage, where possible using data from 2003 to 2007 (DP barcode 359723; USEPA, 2009a). Application rate distributions based on data from 1998 to 2007 were also provided. Based on these data, an 'actual' use pattern was identified for modeling with PRZM/EXAMS to estimate the resulting exposure and to help HED explore whether the reduced exposure would result in dietary risk exceedances (**Table 3**). The 'actual' number of applications per year reflects an average of reported values. The 'actual' application rate reflects the maximum values of the reported distributions. This "actual use pattern" was used in this assessment for the proposed use on dry bulb onions as well as the proposed uses on garlic and shallots.

Table 3. Actual use pattern for the proposed uses of oxamyl.

Use Pattern	Single App. Rate (lbs a.i./A)	No. of App. per Year	Seasonal App. Rate (lbs a.i./A)	App. Interval (days)	App. Method
Dry bulb onions	0.5	7	3.5	5	Aerial

The 'actual' number of applications per year and single application rate were less than the maximum values allowed by the label for the proposed uses on dry bulb onions, garlic, and shallots. Associated application methods and intervals were changed to reflect maximum labeled use instructions at actual application rates. For example, the associated application method to dry bulb onions is aerial application and the interval is 5 days, both of which apply only to application rates at or less than 1 pound of active ingredient per acre (lb a.i./A) (0.5 lbs a.i./A in this case).

2. ANALYSIS

2.1. Environmental Fate and Transport Characterization

Oxamyl [(*EZ*)-N,N-dimethyl-2-methylcarbamoyloxyimino-2-(methylthio)acetamide; CAS# 23135-22-0; PC Code 103801] is hydrophilic, mobile to highly mobile, and relatively nonvolatile (see **Figure 2** for structure). The compound dissipates in the environment by chemical and microbially-influenced degradation and by leaching, with estimated half-lives on the order of days to weeks. **Table 4** is a tabulated summary of the submitted environmental fate data for oxamyl that are acceptable for use in exposure assessment. The environmental fate of oxamyl is further characterized in the previous assessment (DP barcode 351367; USEPA, 2009).

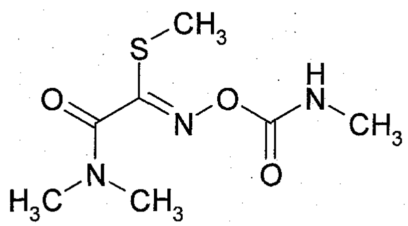

Figure 2. Structure of Oxamyl.

Table 4. General Chemical Properties and Environmental Fate Parameters of Oxamyl.		
Parameter	**Value**	**Reference**
	Physical/Chemical Parameters	
Molecular mass	219.3 g/mol	MRID 40499702
Vapor pressure (25°C)	3.84×10^{-7} torr	MRID 42526101
Water solubility (20°C)	2.82×10^{5} mg/L	MRID 40499702
Octanol-water partition coefficient (K_{OW})	0.36	MRID 40499702
	Persistence	
Hydrolysis half-life	pH 5: >31 d pH 7: 8 d pH 9: 0.125 d	MRID 40606516
Aqueous photolysis half-life	14.2 d (pH 5)	MRID 40606515; 41058801
Soil photolysis half-life	No evidence of degradation	Acc. No. 147704
Aerobic soil metabolism half-life	11 d (silt loam, pH 6.4, OM 2.8%) 17 d (silt loam, pH 6.4, OM 2.8%)	Acc. No. 63012
	11 d (sandy clay loam, pH 7.7, OM 1.5%)	MRID 42820001
	2.9 d (silt loam, pH 7.0, OM 0.4%) 4.6 d (silt loam, pH 7.8, OM 2.1%) 112 d (silty clay loam, pH 4.8, OM 4.4%)	MRID 45176602
Anaerobic soil metabolism half-life	5.2 d (silt loam, pH 4.6, OM 3.7%) 5.8 d (sandy clay loam, pH 7.7, OM 1.5%)	MRID 41346201 MRID 42820001
Aerobic aquatic metabolism half-life	3.4 d; hydrolysis-corrected: 6.1 d (sandy loam, pH 6.6-7.8) 3.5 d; hydrolysis-corrected: 6.3 d (sandy loam, pH 6.9-8.3)	MRID 45045305
	Mobility	
Organic carbon partitioning coefficient (K_{OC})	10-60 L/kg_{OC} (5 soils) 6-10 L/kg_{OC} (3 soils) 2.5-8.7 L/kg_{OC} (6 soils)	MRID 46237301 Bilkert and Rao, 1985 Bromilow et al, 1980
Column leaching (% parent in leachate; % identified residues in leachate)	<0.2-83%; 89-100% (6 unaged soils) 21-50%; 37-67% (3 aged soils)	Acc. No. 141395 MRID 40606514
	Field Dissipation	
Terrestrial field dissipation half-life	Not determined (NY) Not determined (CA) 4 d (DE) 3 d (FL), 4 d (CA), 19 d (WA) 8.6 d (MS) (Oxamyl detected at deepest sample depths of each study.)	Acc. No. 145302 Acc. No. 149231 Acc. No. 40494 MRID 41573201; 41963901 MRID 45045304

2.1.1. Residues of Concern

Oxamyl alone is the residue of concern in drinking water that is included in this assessment. The major degradates identified in the IRED, oxime and DMOA, are not considered in the IRED to be of toxicological concern (USEPA, 2000). The remaining major degradates of oxamyl, DMCF and DMEA, are possible degradates of oxime and are not structurally similar to oxamyl parent. Therefore, they are not considered of toxicological concern.

2.2. Drinking Water Exposure Modeling

Estimated drinking water concentrations (EDWCs) were generated using EFED's standard suite of models. The models, Pesticide Root Zone Model (PRZM v3.12.2; May 12, 2005; Carousel *et al.*, undated) linked with EXposure Analysis Modeling System (EXAMS v2.98.4.6; Apr. 25, 2005; Burns, 2004) via the PRZM/EXAMS model shell (PE v5.0, Nov. 15, 2006), *i.e.*, PRZM/EXAMS, and Screening Concentration in Ground Water (SCI-GROW v2.3, Jul. 29, 2003), were run to estimate screening-level exposure of drinking water sources to oxamyl. The PRZM model simulates pesticide movement and transformation on and across the agricultural field resulting from crop applications. The EXAMS model simulates pesticide loading via runoff, erosion, and spray drift assuming a standard watershed of 172.8 ha that drains into an adjacent standard drinking water index reservoir of 5.26 ha, an average depth of 2.74 m. A more detailed description of the index reservoir watershed can be found in Jones *et al.*, 1998. The coupled PRZM/EXAMS model and users manuals may be downloaded from the U.S. Environmental Protection Agency (EPA) Water Models web-page (USEPA, 2009a). Regional Percent Cropped Areas (PCA) that account for the maximum area within a watershed that may be planted with the modeled crop are applied to concentrations predicted by PRZM/EXAMS.

SCI-GROW is a regression model used as a screening tool to estimate pesticide concentrations found in ground water used as drinking water. SCI-GROW was developed by fitting a linear model to ground water concentrations with the Relative Index of Leaching Potential (RILP) as the independent variable. Ground water concentrations were taken from 90-day average high concentrations from Prospective Ground Water studies. The RILP is a function of aerobic soil metabolism and the soil-water partition coefficient. The output of SCI-GROW represents the concentration of oxamyl residue that might be expected in shallow unconfined aquifers under sandy soils, which is representative of the ground water most vulnerable to pesticide contamination and likely to serve as a drinking water source. The SCI-GROW model and user's manual may also be downloaded from the EPA Water Models web-page (USEPA, 2009a).

2.2.1. Input Parameters

2.2.1.1. Ground Water Modeling

The model input parameters used in SCI-GROW to estimate a screening level of exposure in ground water are listed in **Table 5**. Because the model reflects total annual application rates and is insensitive to single applications rates and numbers of application, the proposed uses were modeled at 1.5 lbs a.i./A times three applications per year in order to achieve the labeled maximum annual application rate of 4.5 lbs a.i./A.

Table 5. SCI-GROW input parameters for the proposed uses of oxamyl.			
Input Parameter	**Value**	**Comment**	**Source**
Application Rate (lbs a.i./A)	1.5	Output reflects total applied per year and is not sensitive to how many single applications occur.	Proposed label
Applications per Year	3		
Organic Carbon Partition Coefficient (K_{OC}) (L/kg$_{OC}$)	10	Represents the lowest K_{OC} value, which is used when variation is greater than three-fold.	MRID 46237301
Aerobic Soil Metabolism Half-life (days)	11	Represents the median of six half-lives (range 2.9 – 112).	Acc. No. 63012 MRID 42820001 MRID 45176602

The lowest organic carbon partition coefficient (K_{OC}) value reported in MRID 46237301 was used for the K_{OC} model input because reported values have more than three-fold variation. K_{OC} values from the open literature were not used in exposure modeling because of uncertainty in the robustness of the studies. The median of the six acceptable aerobic soil metabolism half-lives was used for the aerobic soil metabolism half-life model input.

2.2.1.2. Surface Water Modeling

Chemical Inputs

The general chemical and environmental fate data for oxamyl listed in **Table 4** were used for generating model input parameters for PRZM and EXAMS (listed in **Table 6**). These inputs were determined in accordance with current divisional guidance (USEPA, 2002) and are the same as in the previous assessment (DP barcode 351367; USEPA, 2009). Divisional guidance indicates that the hydrolysis rate at pH 7 (half-life of 8.0 days for oxamyl) should be modeled, which was done for exposure estimation. However, oxamyl is relatively stable to hydrolysis in acidic water bodies. Therefore, exposure estimates in acidic water bodies are expected to be higher than those modeled in this assessment.

Table 6. PRZM and EXAMS Chemical Input Parameters for Oxamyl.			
Input Parameter	**Value**	**Comment**	**Source (MRID)**
Molecular Mass (g/mol)	219	Product chemistry data	40499702
Vapor Pressure (torr)	3.8×10^{-7}	Product chemistry data	42526101
Solubility in Water (mg/L)	2.8×10^{5}	Product chemistry data	40499702
Organic Carbon Partition Coefficient (K_{OC}) (L/kg$_{OC}$)	35	Represents the average K_{OC}.	46237301
Aerobic Soil Metabolism Half-life (days)	52	Represents the upper 90% confidence bound on the mean of six half-lives.	Acc. No. 63012 42820001 45176602
Aerobic Aquatic Metabolism Half-life (days)	6.6	Represents the upper 90% confidence bound on the mean of two half-lives adjusted for hydrolysis at pH 7.	45045305

Table 6. PRZM and EXAMS Chemical Input Parameters for Oxamyl.			
Input Parameter	**Value**	**Comment**	**Source (MRID)**
Anaerobic Aquatic Metabolism Half-life (days)	0	No data; assumed stable. Aqueous dissipation will be dominated by hydrolysis.	Not applicable
Hydrolysis Half-life (days)	8.0	Half-life at pH 7	40606516
Aqueous Photolysis Half-life (days)	14	Represents the maximum environmental phototransformation half-life.	40606515; 41058801

Chemical property input values were chosen in accordance with current input parameter guidance (USEPA, 2002b). The upper 90% confidence bound on the mean was selected for the aerobic soil metabolism half-life (52 days) and aerobic aquatic metabolism half-life (6.6 days). The pH 7 hydrolysis half-life (8 days) was used and since hydrolysis is a dominant process in aqueous environments and since there are no submitted data for anaerobic aquatic metabolism, it was assumed stable. The average K_{OC} value (35 L/kg_{oc}) was selected for modeling.

Use Pattern Inputs

The model input parameters used in PRZM to simulate oxamyl application and crop management practices are provided in **Table 7**. The use pattern on the proposed label (EPA Reg. No. 352-532) that produces the maximum estimated aquatic exposure was assessed. Application timing of oxamyl is related to various pest pressures. For the purposes of this assessment, it was usually assumed that post-emergence applications were made two weeks after crop emergence, as specified in the standard scenarios. Initial application dates were selected in order to reflect labeled crop timing for applications, consistent with the crop timing set by the model scenarios and with crop-profile information provided by the United States Department of Agriculture (USDA, 2008).

For this refined assessment, multiple scenarios were modeled, if available, for each use, in order to provide exposure estimates relevant to regions of the United States. These regions are large because there are a limited number of scenarios per use, which requires the few scenarios to act as surrogates for large areas of the United States.

Table 7. PRZM Scenarios and Input Parameters Describing the Maximum Proposed Oxamyl Use Pattern.								
Uses	**Scenario**	**Date of Initial App.**	**App. Rate (lbs a.i./A)**	**App. per Year**	**App. Interval (days)**	**CAM Input**	**IPSCND Input**	**Application Efficiency/ Spray Drift**
Dry onions, shallots	CA onion STD	Jan 30	2.0, 0.5[a]	3	14	2	1	0.99/0.064
	WA onion NMC	Jun 15						
Dry onions, shallots, garlic	PA vegetable NMC	May 24						
	GA onion STD	Oct 1						
Garlic	CA garlic RLF	Oct 15						

a The initial two applications are 2.0 lbs a.i./A, followed by one application at 0.5 lbs a.i./A in order to total 4.5 lbs a.i./A/season.

Although uses of oxamyl are seasonally limited, whereas model inputs must be annually limited, all modeled uses of oxamyl have only one season per year. Therefore, seasonal use patterns were modeled as annual use patterns.

Regional PCA Refinement

The exposure estimates from PRZM/EXAMS were multiplied by regional percent cropped area factors (PCA) for HUC-2 watershed basins of the United States in order to account for the highest extent of watershed in the regions on which agricultural crops are grown (Effland *et al.*, 1999). **Figure 3** displays the 18 HUC-2 watershed basins of the contiguous United States for which regional PCA factors are calculated.

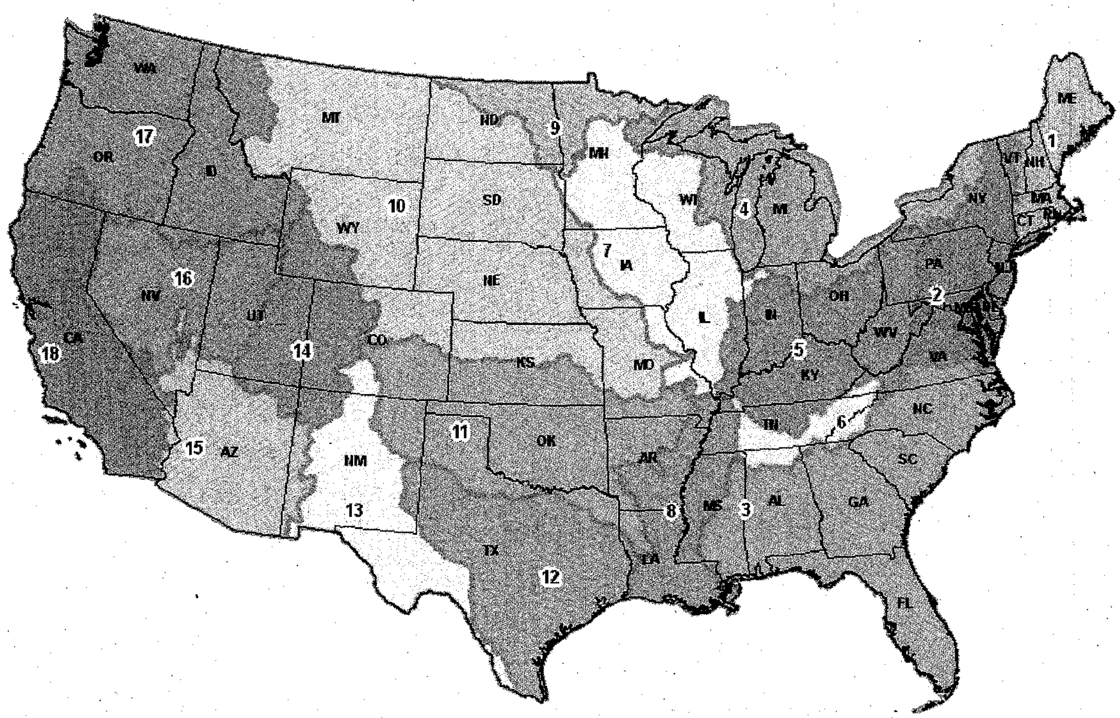

Figure 3. The Eighteen HUC-2 Watershed Basins of the Contiguous United States.

The first step in this process was to use 2002 AgCensus data (*i.e*, dot-density maps) to ascertain the states in which onions are grown at a density sufficient to be mapped (USDA, 2008a). These data were used to tabulate states per PCA region where oxamyl might be applied to all of the proposed uses on dry bulb onions, garlic, and shallots (**Table 8**).

The second step was to assign a PRZM/EXAMS scenario for modeling each use-PCA region combination where oxamyl might be applied. Dry bulb onions and shallots were grouped together at this step due to the similarity in crop and the unavailability of a model scenario for shallots (**Table 8**). The strategy for assigning surrogate model scenarios was to use current scenarios to represent areas of similar meteorological and agronomic conditions. For the proposed uses, current scenarios representing areas west of the Rockies were used to represent large regions west of the Rockies that were generally to the south and/or east of the scenario location. Similarly, current scenarios representing areas east of the Rockies were used to represent large regions east of the Rockies that were generally to the south and/or west of the scenario location.

Following the assignment of model scenarios to each use-PCA region combination, the modeling was conducted and the regional PCA-adjusted 1-in-10-year peak EDWCs were tabulated for each combination of use and PCA region (**Table 8**), as discussed in the Modeling Results section below.

Table 8. Regional PCA Assessment Refinement.

Major Basin #	Basin Name	Regional PCA	States Where Dry Onions are Grown.	Scenario Assignments for Dry Onions and Shallots	Dry Onion/ Shallot EDWCs (µg/L)[a]	Scenario Assignments for Garlic	Garlic EDWCs (µg/L)[a]
East of Eastern Divide							
1	New England	14	CT, MA	PA vegetable NMC	11	PA vegetable NMC	11
2	Mid Atlantic	46	MD, NY	PA vegetable NMC	36	PA vegetable NMC	36
3	South Atlantic	38	GA, SC, NC	GA onion STD	51	GA onion STD	51
Mid-Continent (Mississippi River Basin)							
4	Great Lakes	77	NY, MI, WI, OH	PA vegetable NMC	61	PA vegetable NMC	61
5	Ohio	82	PA	PA vegetable NMC	65	PA vegetable NMC	65
6	Tennessee	38					
7	Upper Mississippi	85	MN, WI, IL	PA vegetable NMC	67	PA vegetable NMC	67
8	Lower Mississippi	85					
9	Souris	83					
10	Missouri	87	CO, ND	PA vegetable NMC	69	PA vegetable NMC	69
11	Arkansas	80	MO, CO, KS, TX	GA onion STD	**108**	GA onion STD	**108**
12	Texas Gulf	67	TX, NM	GA onion STD	**90**	GA onion STD	**90**
13	Rio Grande	28	TX, NM, CO	CA onion STD	3.5	CA garlic RLF_V2	3.7
West of Western Divide							
14	Upper Colorado	7	CO	WA onion NMC	1.6	CA garlic RLF_V2	0.92
15	Lower Colorado	11	AZ, CA	CA onion STD	1.4	CA garlic RLF_V2	1.4
16	Great Basin	28	NV, UT	CA onion STD	3.5	CA garlic RLF_V2	3.7
17	Pacific Northwest	63	OR, WA, ID	WA onion NMC	17	CA garlic RLF_V2	8.3
18	California	56	CA, OR	CA onion STD	6.9	CA garlic RLF_V2	7.3

a Values >80 µg/L are in bold.

2.2.2. Modeling Results

Proposed use patterns were modeled for surface water and ground water exposure estimates, as described above. Current and proposed use patterns were also modeled in the previous assessment (DP barcode 351367; USEPA, 2009). The use patterns that yielded the maximum surface water and ground water EDWCs for use in drinking water exposure estimation were carrots and ginger root, respectively, which are also the maximum use patterns for the current drinking water exposure assessment.

2.2.2.1. Ground Water Results

Tier I acute and chronic exposure estimates in ground water from SCI-GROW ranged up to 1.3 µg/L (**Table 9**). Use on ginger root resulted in the maximum exposure estimate in shallow ground water (1.3 µg/L). The proposed uses on dry bulb onions, garlic, and shallots resulted in an exposure estimate an order of two lower (0.57 µg/L). Further refinement of ground water modeling was not pursued because HED indicated that the maximum exposure estimate did not result in dietary exceedances of levels of concern (personal communication with Sheila Piper, Nov. 19, 2008).

Table 9. Tier I estimated drinking water concentrations (EDWCs) in ground water resulting from application of oxamyl (maximum values in bold).

Use	Maximum annual application rate	1-in-10 year peak (µg/L)	1-in-10 year annual mean (µg/L)	30- year mean (µg/L)
Dry bulb onions, garlic, shallots	4.5 lbs a.i./A/year	0.57	0.57	<0.57
Ginger root	10 lbs a.i./A/year	**1.3**	**1.3**	**<1.3**

2.2.2.2. Surface Water Results

Regional PCA-adjusted acute and chronic exposure estimates in surface water drinking water sources from PRZM/EXAMS are listed in **Table 10**. Use on carrots in the Lower Mississippi watershed basin resulted in the highest estimated peak exposure (1-in-10-year peak of 300 µg/L). The proposed uses on dry bulb onions, garlic, and shallots resulted in a 1-in-10-year peak exposure estimate of 108 µg/L. This exposure estimate represents the most vulnerable combination of modeled scenario and regional PCA. This estimate is 20% higher than the 1-in-10-year peak exposure estimate for the currently labeled use on onions (90 µg/L) that was modeled in the previous assessment (DP barcode 351367; USEPA, 2009). This is because the Arkansas watershed basin to which these estimates apply was represented in this assessment by a more vulnerable model scenario (GA onion) that is a better surrogate for the wider geographical area of the basin in which oxamyl may be applied than the scenario used in the previous assessment, based on meteorological and agronomic conditions.

Table 10. Tier II estimated drinking water concentrations (EDWCs) adjusted by maximum PCAs resulting from application of oxamyl (maximum values in bold).

Use (modeled rate)	PCA[a]	PRZM Scenario	1-in-10 year acute (µg/L)	1-in-10 year chronic (µg/L)	30- year mean (µg/L)
Carrots (8 lbs a.i./A/year)	85%	STX vegetable	**300**	**6.4**	2.7
Dry bulb onions, Shallots, Garlic (4.5 lbs a.i./A/year)	80%	GA onion	108	2.3	0.69

a The PCA is the highest regional PCA applicable to the modeled scenario. EDWCs are adjusted by these maximum regional PCAs.

Regional PCA Refinement

As stated above, regional PCA-adjusted 1-in-10-year peak EDWCs were tabulated for each combination of use and HUC-2 watershed basin (**Table 8**). A preliminary table of exposure estimates was delivered to HED in October, 2008 (DP barcode 357440; USEPA 2008). Based on this information, HED indicated in November, 2008 that dietary levels of concern (for food plus water and accounting for number of eating occasions per day) are generally exceeded when EDWC time series are represented by a 1-in-10-year peak value near or above 80 µg/L (personal communication with Sheila Piper, Nov. 19, 2008). Therefore, the values on **Table 8** that exceed this value have potential to result in exceedances of dietary levels of concern. Using this information, the proposed uses on dry bulb onions, garlic, and shallots may result in EDWCs that exceed this value in some parts of the United States (*i.e.*, the Arkansas and Texas Gulf watersheds). HED analysis is necessary to accurately estimate dietary risk from these uses.

Exposure Characterization for Actual Rates

In order to characterize reductions in exposure estimates resulting from potential changes to the proposed and currently labeled use patterns, usage data were requested from the Biological and Economic Analysis Division (BEAD) for the uses (carrots, peppers, oranges, grapefruit, lemons, cotton, cucumber, onions, sugar beets, and tomatoes) and regions where EDWCs exceeded 80 µg/L in the previous assessment (DP barcode 351367; USEPA, 2009). BEAD provided the requested usage data at the state-level and at the application level, such as per crop stage, where possible using data from 2003 to 2007 (DP barcode 359723; USEPA, 2009a). Application rate distributions based on data from 1998 to 2007 were also provided. Based on these data, an 'actual' use pattern for onions was identified (**Table 3**) for modeling with PRZM/EXAMS to estimate the resulting exposure from the proposed uses and to explore whether the exposure would remain at levels expected to exceed 80 µg/L.

Table 11 lists the model input parameters used in PRZM to simulate the actual use pattern that was identified in **Table 3** to represent more typical usage of oxamyl than the maximum use pattern that resulted in exceedances of 80 µg/L. This use pattern was also modeled using the chemical input parameters listed in **Table 6**.

Table 11. PRZM Input Parameters Describing Less-Than-Maximum Oxamyl Use Patterns.

Uses	Scenario	Date of Initial App.	App. Rate (lbs a.i./A)	App. per Year	App. Interval (days)	CAM Input	IPSCND Input	Application Efficiency/ Spray Drift
Dry onions, shallots, garlic	GA onion STD	Oct 1	0.5	7	7	2	1	0.95/0.16

The resulting regional PCA-adjusted 1-in-10-year peak exposure estimates in surface water drinking water sources are listed in **Table 12** for the use-watershed region combinations that exceeded 80 µg/L for the maximum labeled use patterns (cells with highlighted values in **Table 8**). These results indicate that actual application patterns reduce exposure estimates for the proposed uses well below 80 µg/L. As mentioned above, HED analysis is necessary to accurately estimate dietary risk from these uses at any application rate.

Table 12. EDWCs (µg/L) from actual use patterns by use and by regional PCA specific to each major watershed basin where that use may occur.			
Major Basin #	**Basin Name**	**Regional PCA**	**Dry bulb onions, Shallots, Garlic**
11	Arkansas	80	46
12	Texas Gulf	67	38

2.3. Monitoring Data

The available monitoring data discussed in the previous assessment (DP barcode 351367; USEPA, 2009) suggest that oxamyl may be detected in ground water and surface water at up 395 µg/L and 2.8 µg/L, respectively, in vulnerable areas. Although oxamyl was not detected in most samples, the surface water monitoring studies did not target oxamyl use areas or times of known oxamyl use and, thus, may not necessarily reflect potential peak oxamyl concentrations that may occur in surface waters when runoff events occur shortly after oxamyl is applied. However, the data suggest that oxamyl is not likely to be found in most surface waters and, when it is found, is not likely to persist.

Oxamyl is not expected to persist in neutral to alkaline aquatic environments. However, targeted and non-targeted ground water monitoring has detected concentrations as high as several hundred µg/L in vulnerable areas. More typical maximum concentrations observed in targeted studies are an order of magnitude less. Results of prospective ground water monitoring studies indicate that oxamyl may persist in some acidic ground water environments, which is supported by non-targeted monitoring conducted in Suffolk County, New York, where the compound has remained above detection limits (typically at <1 µg/L) since the compound was voluntarily restricted from use in 1982 (Trent, 2009).

These results are consistent with our understanding of the fate and transport properties of oxamyl. The highest detections of oxamyl in surface water in the monitoring data (up to 2.8 µg/L in surface water) are consistent with 1-in-10-year annual average EDWCs of oxamyl in surface water (up to 6.4 µg/L) for uses on individual crops. The highest detections of oxamyl in ground water (up to 395 µg/L detected in Suffolk County, New York in the 1980's) are two orders of magnitude higher than screening estimated concentrations in ground water (up to 1.3 µg/L) and monitored concentrations from prospective ground water studies (up to 3.9 µg/L). High detections from most ground water monitoring studies are consistent with estimated values. Oxamyl may be relatively persistent in some acidic ground water environments. Changes in oxamyl detections due to label mitigations specified in the RED cannot yet be observed, as the RED mitigations were implemented in 2007, after which monitoring data are not yet available.

2.4. Drinking Water Treatment

According to the N-Methyl Carbamate Cumulative Risk Assessment, a review of available laboratory studies and monitoring data by EPA indicates that conventional water treatment processes such as coagulation, sedimentation, and conventional filtration will not reliably remove or transform the N-methyl carbamates such as oxamyl in drinking water sources (USEPA, 2007). Lime softening and activated carbon filtration can be effective in removing N-methyl carbamate pesticides such as oxamyl. Lime softening processes will break down oxamyl through alkaline-catalyzed hydrolysis. Sorption on activated carbon using granular activated carbon (GAC) or powdered activated carbon (PAC) appears to be at least partially effective in removing oxamyl from drinking water (percent removal ranges from 20 to 38% for oxamyl).

3. CONCLUSIONS

Tier II drinking water exposure estimates of oxamyl are represented by the maximum use patterns for oxamyl, carrots (for surface water) and ginger root (for ground water; **Tables 1, 9, and 10**). For the modeled uses, acute EDWCs were up to 300 μg/L for surface water and up to 1.3 μg/L for ground water. Chronic and cancer EDWCs were up to 6.4 μg/L and up to 3.1 μg/L, respectively, for surface water.

Monitoring data suggest that oxamyl may be detected in ground water and surface water at up 395 μg/L and 2.8 μg/L, respectively, in vulnerable areas. However, maximum ground water concentrations observed in most monitoring studies were typically lower. The data suggest that oxamyl is not likely to be found in most surface waters and, when it is found, is not likely to persist. The compound is not expected to persist in neutral to alkaline ground water. Prospective ground water monitoring and non-targeted monitoring indicate that oxamyl may persist in some acidic ground water environments.

The modeling assessment relied on maximum use patterns and regional PCA values. To the extent that actual use patterns are less than the labeled maximums and the location-specific PCAs are less than assumed in this assessment, actual environmental exposures could be lower. Modeled exposure estimates throughout this document are uncertain to the extent that the ranges of possible initial application dates were not modeled in order to characterize the exposure resulting from initial application occurring on the dates of most and least vulnerability and their relation to the selected date.

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